

Claims

- [c1] 1. A changeable lock assembly that can be reconfigured to operate with different keys of a set of user key, without disassembling the lock, comprising:
- a) a housing having a generally cylindrical bore with an inner surface and a plurality of generally cylindrical driver chambers intersecting the bore surface;
 - b) a plurality of generally cylindrical drivers, each driver being positioned and movable within one driver chamber and being urged toward the bore surface;
 - c) a plug having a generally cylindrical periphery and rotatably mounted within the bore so as to form a shear line at the interface of the bore surface and the plug periphery, the plug further having:
 - 1)a longitudinal axis;
 - 2)a keyway intersecting the periphery and parallel to the longitudinal axis and configured to receive a key selected from a subset of keys, the subset of keys including at least a first key having a first contour edge that operates the lock in a first lock configuration but does not operate the lock in a second lock configuration, and a second key having a second contour edge that operates the lock in the second lock configuration but does

not operate the lock in the first lock configuration, wherein the first contour edge and the second contour edge have at least a first contour position and a second contour position that are differently configured;

3) a plurality of generally cylindrical tumbler chambers intersecting the periphery and the keyway and generally orthogonal to the longitudinal axis, each tumbler chamber being aligned with a driver chamber when the plug is at a first rotated position with respect to the housing so as to form a pin chamber; and

4) a plurality of retainer cavities intersecting the periphery, each retainer cavity being spaced apart from a corresponding tumbler chamber and aligned with a corresponding driver chamber when the plug is at a second rotated position with respect to the housing; and

5) a change tool slot configured parallel to the longitudinal axis, that extends from the front face of the plug and intersects a portion of each of the retainer cavities;

d) a plurality of tumblers, each tumbler being positioned and movable within one tumbler chamber;

e) a plurality of lock configuration change balls, each change ball being associated with one pin chamber, having a first position within the pin chamber between the driver and tumbler, and a second position within the retainer cavity, and being movable from the second position within the retainer cavity upon insertion of a change

tool into the change tool slot.

- [c2] 2. The changeable lock assembly of Claim 1 wherein the first contour position of the first key is a lower position and the second contour position of the first key is a raised position, and wherein, when the lock is configured to operate with the first key, a first change ball corresponding to the first contour position is disposed in its pin chamber, and a second change ball corresponding to the second contour position is disposed in its retainer cavity.
- [c3] 3. The changeable lock assembly of Claim 2 wherein the first contour position of the second key is a raised position and the second contour position of the second key is a lower position, wherein the driver that is disposed in the pin chamber corresponding to the second contour position spans across the shear line when the second key is inserted into the keyway, whereby the plug can not rotate within the housing, such that the second key can not operate the lock.
- [c4] 4. The changeable lock assembly of Claim 1 wherein the lock has a reset configuration, wherein, when an operable key is disposed in the keyway and the plug is at the second rotated position, and the change tool is positioned within the change tool slot, any change ball in its

second position has been moved into its corresponding driver chamber.

[c5] 5. A lock kit, comprising:

a) a subset of keys including at least a first key having a first contour edge that operates the lock in a first lock configuration but does not operate the lock in a second lock configuration, and a second key having a second contour edge that operates the lock in the second lock configuration but does not operate the lock in the first lock configuration, wherein the first contour edge and the second contour edge have at least a first contour position and a second contour position that are differently configured;

b) a change tool;

c) a changeable lock assembly that can be reconfigured to operate with different keys without disassembling the lock, comprising:

1) a housing having a generally cylindrical bore with an inner surface and a plurality of generally cylindrical driver chambers intersecting the bore surface;

2) a plurality of generally cylindrical drivers, each driver being positioned and movable within one driver chamber and being urged toward the bore surface;

3) a plug having a generally cylindrical periphery and rotatably mounted within the bore so as to form a shear

line at the interface of the bore surface and the plug periphery, the plug further having:

- (a) a longitudinal axis;
 - (b) a keyway intersecting the periphery and parallel to the longitudinal axis and configured to receive a key selected from the subset of keys;
 - (c) a plurality of generally cylindrical tumbler chambers intersecting the periphery and the keyway and generally orthogonal to the longitudinal axis, each tumbler chamber being aligned with a driver chamber when the plug is at a first rotated position with respect to the housing so as to form a pin chamber; and
 - (d) a plurality of retainer cavities intersecting the periphery, each retainer cavity being spaced apart from a corresponding tumbler chamber and aligned with a corresponding driver chamber when the plug is at a second rotated position with respect to the housing; and
 - (e) a change tool slot configured parallel to the longitudinal axis, that extends from the front face of the plug and intersects a portion of each of the retainer cavities;
- 4) a plurality of tumblers, each tumbler being positioned and movable within one tumbler chamber;
- 5) a plurality of lock configuration change balls, each change ball being associated with one pin chamber, having a first position within the pin chamber between the driver and tumbler, and a second position within the re-

tainer cavity, and being movable from the second position within the retainer cavity upon insertion of the change tool into the change tool slot;

d) instructions for use; and

e) a means for securing the keys, lock assembly, change tool, and the instructions.

[c6] 6. A changeable lock assembly comprising:

a) a housing having a bore therein;

b) a plug rotatably mounted in the said the bore, the plug having:

i) a longitudinal axis;

ii) a first passage parallel to the longitudinal axis, and configured to receive a key selected from a subset of keys, said subset of keys comprising at least a first key and a second key, each key having at least one contour position;

iii) a second passage configured in the plug to receive a change tool, and

c) a change member movable within the lock between a first position in the lock and a second position in the plug, the change member being movable from the first position to the second position solely in response to rotation of the plug by the operation of the second key; wherein when the change member is in the first position, the first key operates the lock, and wherein when the

change member is in the second position, the first key does not operate the lock.

- [c7] 7. A changeable lock assembly comprising:
- a) a housing having a bore therein;
 - b) a plug rotatably mounted in the said the bore, the plug having a longitudinal axis, and a first passage parallel to the longitudinal axis, and configured to receive a key selected from a subset of keys, said subset of keys comprising at least a first key and a second key, each key having at least one contour position; and
 - c) a change member movable within the lock between a first position in the lock and a second position in the plug, the change member being movable from the first position to the second position solely in response to rotation of the plug by the operation of the second key; wherein when the change member is in the first position, the first key operates the lock, and wherein when the change member is in the second position, the first key does not operate the lock.
- [c8] 8. The lock assembly of claim 7, wherein the plug further has a retainer cavity that is configured to receive the change member when the change member is in the second position.
- [c9] 9. The lock assembly of claim 8, wherein the plug further

has a second passage configured in the plug to receive a change tool, the second passage intersecting the retainer cavity, and wherein the change member can be disposed in the retainer cavity when the change tool is not positioned in the second passage.

- [c10] 10. The lock assembly of claim 8, wherein the change member cannot be disposed in the retainer cavity when the change tool is positioned in the second passage.
- [c11] 11. The lock assembly of claim 8, wherein the change member is movable from the first position to the second position when the change tool is not positioned in the second passage.
- [c12] 12. The lock assembly of claim 8, wherein the change member is movable from the second position to the first position when the change tool is positioned in the second passage.
- [c13] 13. The lock assembly of claim 7, wherein the plurality of contour locations includes raised contour locations and lowered contour locations.
- [c14] 14. The lock assembly of claim 13, wherein two contour locations of the plurality of contour locations are raised contour locations, and the remainder of the contour locations are lowered contour locations.

- [c15] 15.The lock assembly of claim 14, wherein the first key has a first top edge contour and the second key has a second top edge contour, the first top edge contour having at least one lowered contour location corresponding to one of the two raised contour locations of the second top edge contour.
- [c16] 16.The lock assembly of claim 7 wherein the plug further has a first groove configured in the plug, the first groove extending radially and outwardly from the longitudinal axis, and further comprising a radial tumbler disposed in the first groove for circumferential motion about the longitudinal axis in the first groove.
- [c17] 17.The lock assembly of claim 16 wherein the radial tumbler comprises a distal end, and further comprising a spring in confronting relationship with the radial tumbler, wherein the spring biases the radial tumbler such that the distal end extends into the first passage.
- [c18] 18.The lock assembly of claim 17, wherein the radial tumbler further has a notch, wherein the housing further has a second groove configured therein, and further comprising a movable side bar disposed in a side bar cavity configured in the plug, the side bar having a proximal end and a distal end, the proximal end adapted to

insert into the notch in the radial tumbler, and the distal end adapted to confront the second groove.

[c19] 19.The lock assembly of claim 16 further comprising a memory block disposed in the first groove and being movable between a first memory block position and a second memory block position, wherein when the memory block is in the first memory block position, the change member cannot move between the first and the second positions, and wherein when the memory block is in the second memory block position, the change member can move between the first and the second positions.

[c20] 20.The lock assembly of claim 19, wherein the memory block is in the first memory block position when the change tool is not in the second orifice.

[c21] 21.The lock assembly of claim 19, wherein the memory block is in the second memory block position when the change tool is in the second orifice.

[c22] 22.The lock assembly of claim 11, further comprising a shim disposed in the lock adjacent to the change member when the change member is in the first position.

[c23] 23.The lock assembly of claim 22, wherein the shim has a first diameter and the retainer cavity has a second diameter, the first diameter being greater than the second

diameter.

- [c24] 24. A method for reprogramming a lock, the method comprising:
- a) providing an adaptable lock assembly comprising a housing having a bore therein, a plug rotatably mounted in the bore, the plug having a longitudinal axis, the plug further including a first orifice parallel to the longitudinal axis, the first orifice adapted to receive a key selected from a subset of keys, the subset of keys including at least a first key and a second key, and a change member movable within the lock between a first position in the lock and a second position in the plug, the change member being movable from the first position to the second position solely in response to rotation of the plug by operation of the second key, wherein when the change member is in the first position, the first key operates the lock, and wherein when the change member is in the second position, the first key does not operate the lock;
 - b) providing a subset of keys, the subset of keys including at least a first key and a second key, each of the first key and the second key including a top contour, the second key having a different top contour than the first key, the first key being operable to operate the lock;
 - c) inserting the second key into the first orifice; and
 - d) moving the change member from the first position to

the second position such that the first key is inoperable to operate the lock.

[c25] 25.The method of claim 24, wherein the plug further includes a second orifice disposed in the plug, the second orifice intersecting a retainer cavity adapted to receive the change member, the second orifice adapted to receive a change tool.

[c26] 26.The method of claim 25, wherein moving the change member from the first position to the second position further comprises rotating the plug in the housing.

[c27] 27.The method of claim 25, further comprising the step of moving the change member from the second position to the first position.

[c28] 28.The method of claim 27, wherein moving the change member from the second position to the first position further comprises inserting the change tool in the second orifice, rotating the plug in the housing, and subsequently removing the change tool from the second orifice.

[c29] 29.The method of claim 25 further comprising a memory block disposed in the plug and movable between a first memory block position and a second memory block position, wherein when the memory block is in the first

memory block position, the change member cannot move between the first and the second positions, and wherein when the memory block is in the second memory block position, the change member can move between the first and the second positions.

[c30] 30. The method of claim 29, further comprising moving the memory block from the first memory block position to the second memory block position.

[c31] 31. The method of claim 30, wherein moving the memory block from the first memory block position to the second memory block position further comprises inserting the change tool into the second orifice.

[c32] 32. The method of claim 31, further comprising moving the memory block from the second memory block position to the first memory block position.

[c33] 33. The method of claim 32, wherein moving the memory block from the second memory block position to the first memory block position further comprises removing the change tool from the second orifice.

[c34] 34. A changeable lock assembly, comprising
a) a housing having a generally cylindrical bore with an inner surface and a plurality of generally cylindrical driver chambers intersecting the bore surface;

b) a plurality of generally cylindrical drivers, each driver being received by and movable within one driver chamber and being urged toward the bore surface;

c) a plug having a generally cylindrical periphery and rotatably mounted within the bore so as to form a shear line at the interface of the bore surface and the periphery, the plug further having:

1) a longitudinal axis;

2) a keyway configured parallel to the longitudinal axis and configured to receive a key selected from a subset of keys, the subset of keys including at least a first key and a second key, the first and second key each having an edge with at least one contour position that is differently configured;

3) a plurality of generally cylindrical tumbler chambers intersecting the periphery and the keyway and generally orthogonal to the longitudinal axis, the tumbler chambers being equal to the number of driver chambers and being aligned therewith when the plug is at a first position with respect to the housing so as to form a pin chamber, such that when the plug is in the first position and at least one of the drivers is urged so as to intersect the shear line, the plug cannot be rotated within the housing;

4) a plurality of retainer cavities intersecting the periphery and spaced apart from a corresponding tumbler

chamber, the retainer cavities being aligned with a corresponding driver chamber when the plug is at a second position with respect to the housing;

d) a plurality of tumblers, each tumbler being received by and movable within one tumbler chamber;

e) a plurality of lock configuration change members, at least one change member being positioned in the each pin chamber between a driver and tumbler, at least one of the change members being responsive to the at least one contour position when the second key is inserted into the keyway such that the change member is disposed wholly within the driver chamber and can be moved within the lock to one of the retainer cavities when the plug is rotated from the first to second position; and

f) the plug being rotatable after insertion of: (1) the first key when the one change member is within tumbler chamber; and (2) the second key when the change member is in the one retainer cavity.

[c35] 35. A changeable lock assembly comprising:

a) a housing having a bore therein;

b) a plug rotatably mounted in the bore, the plug having a longitudinal axis, the plug further including a first passage parallel to the longitudinal axis, the first passage adapted to receive at least a first key and a second key;

and

c) first and second subsets of pin chambers, wherein each pin chamber of the first subset of pin chambers lies in a first plane perpendicular to the longitudinal axis, and wherein each pin chamber of the second subset of pin chambers lies in a second plane perpendicular to the longitudinal axis, and wherein the first plane and the second plane are not coplanar.

[c36] 36. A method of making a changeable lock plug by machining a standard lock plug, comprising the steps of:

a) providing a standard lock plug having a keyway, an axial centerline and a circumferential surface, the standard plug further having a plurality of tumbler chambers extending through the circumferential surface along a first line extending parallel to the axial centerline, wherein each tumbler chamber extends into the keyway and has a centerline that is spaced apart by a first distance from an adjacent tumbler chamber; and

b) machining a plurality of retainer cavities into the standard plug through the circumferential surface along a second line extending parallel to the axial centerline, wherein each retainer cavity extends into the plug body is displaced radially from a corresponding tumbler chamber by an arc angle along the circumferential surface.

- [c37] 37. The method according to Claim 36, further comprising the step of c) cutting a slot along the axial direction in the outer surface of the plug along the same line as the retainer cavities.
- [c38] 38. The method according to Claim 36 further comprising the step of installing pins, springs, and a change ball in a programmed arrangement, in assembling the plug into the lock housing.
- [c39] 39. The method according to Claim 36 wherein the retainer cavities are drilled 95% of the size of a driver used in the tumbler chamber.
- [c40] 40. A method of machining a plug for a variable change lock, comprising:
- a) providing a plug body having a keyway, an axial centerline, and a circumferential surface;
 - b) machining a plurality of tumbler chambers through the circumferential surface along a first line extending parallel to the axial centerline, wherein each tumbler chamber extends into the keyway and has a centerline that is spaced apart by a first distance from an adjacent tumbler chamber;
 - c) machining a plurality of retainer cavities through the circumferential surface along a second line extending

parallel to the axial centerline, wherein the retainer cavities extend into the plug body, and each retainer cavity is displaced radially from a corresponding tumbler chamber by an arc angle along the circumferential surface; and

d) machining a slot through the circumferential surface and along the second line.

[c41] 41. The method according to Claim 40 wherein the retainer cavity has an effective diameter, and the retainer cavity is machined to a depth of at least one effective diameter.

[c42] 42. The method according to Claim 40 wherein the tumbler chambers and retainer cavities are machined simultaneously.

[c43] 43. The method according to Claim 40 wherein the arc angle is between about 30° and about 120° from the first line.